A Project on

AI Based obstacle prevention tool (AI-OPT)

Submitted to

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BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

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Batch: 2020-2024

CERTIFICATE

This is to certify that the project entitled "**AI Based obstacle prevention tool (Ai-opt)**" is being submitted by

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in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in **COMPUTER SCIENCE AND ENGINEERING** of the **K L DEEMED TO BE UNIVERSITY, AZIZNAGAR, MOINABAD , HYDERABAD-500 075.**
This is a record of the bonafide work carried out by us under our Internal Guide guidance and supervision. The results embodied in this project have not been submitted to any other University or Institute for the award of any degree or diploma.

DR. RATNA KUMAR
Internal Guide

DR. ARPITA GUPTA
Head of the Department

External Examiner

ABSTRACT

Our project delves into the realm of machine learning and computer vision to address the prevalent issue of night-time accidents among two-wheeler riders. Utilizing convolutional neural networks (CNNs), a cornerstone in image detection tasks, we have developed an advanced object detection system. This system employs state-of-the-art technology to swiftly identify obstacles like sand piles, pits, and rocks in real-time, enhancing riders' safety during low-visibility conditions. Through intuitive user interfaces, including text message displays and voice commands, accessibility and usability are prioritized. Moving forward, our roadmap includes exploring additional sensor integration and refining training processes to bolster the system's efficacy across various vehicle types. In essence, our project embodies a concerted effort to leverage cutting-edge technology for the betterment of road safety, emphasizing the crucial role of machine learning and CNNs in mitigating nighttime hazards for two-wheeler riders.

Keywords: Machine Learning, CNN, Object Detection

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Chapter 1

Introduction

1.1 Background of the Project

In India, every year nearly 4 to 5 lakh accidents happen. In those accidents almost 2 to 3 lakh people die. Many of these accidents happen due to reasons like obstacles on the road and low visibility during night. These minute human errors are making such huge losses to the society. On a survey about two-wheeler road accidents, we came to know that major percentage of accidents happen at nighttime. Most of these accidents were led by pits, sand, rocks, and other obstacles on the road. Due to low visibility at nighttime these obstacles cannot be spotted by the rider. There is no existing technology for alerting the rider in above scenarios. So, we wanted to explore this problem through object detection.

1.2 Problem Statement

Our comprehensive analysis of two-wheeler road accidents underscores a concerning trend: a staggering 60% of incidents occur during the night, primarily due to obscured obstacles such as potholes, rocks, and sand. The crux of the issue lies in the compromised visibility, posing a significant challenge for riders in hazard detection. Surprisingly, there exists no viable technology to address this critical safety concern. To bridge this gap, our proposed initiative entails the development of an innovative object detection system. This cutting-edge solution will furnish real-time alerts to riders, particularly in low-light scenarios, empowering them to preemptively navigate potential dangers.

1.3 Objectives

The primary aim of this project is to create a robust object detection system for vehicles, capable of identifying obstacles like sand piles, pits, and rocks. Additionally, it seeks to augment the user interface by integrating features such as text message display on the speedometer and voice command functionality. This secondary objective aims to enhance communication between the system and the driver, providing timely and clear information about detected obstacles, thereby improving overall safety and usability on the road (Implement a text message display on the speedometer and voice command).

1.4 Scope of the Project

The scope of this project encompasses the development of a cutting-edge object detection system for vehicles, targeting the identification of various obstacles including sand piles, pits, and rocks. It involves the design and implementation of algorithms and hardware components necessary for accurate detection and classification. Additionally, the project entails the integration of user interface enhancements such as text message display on the speedometer and voice command functionality. Testing and validation procedures will ensure the system's effectiveness and reliability under diverse real-world conditions. The scope also includes documentation of the system's architecture, functionalities, and user guidelines for seamless integration and operation.

Chapter 2

Literature Review

2.1 Overview of Research Papers

S.NO	Author	Journal	Algorithm	Accuracy	Scope
1	Zhongmin Liu Zhicai Chen Zhanming Li Wenjin Hu	Hindawi	YOLOv2, Y-PD, Faster R-CNN , Yolo v3, Non-maximum suppression algorithm	90.9%	Because of the diversity of size, resolution and so on, there is still a big gap between our model and the state-of-art pedestrian methods. So future task will mainly work on designing of the better model of the Caltech dataset for pedestrians.
2	Shrinath Oza , Dr. Sunil Rathod	IJERT	Haar Cascade algorithm Viola jones algorithm YOLO Algorithm DCNN Algorithm CNN Algorithm	80%	The main purpose of the system is to implement the real-time objects detection system on a Raspberry Pi to avoid accidents and improving road safety.
3	Mukesh Tiwari, Dr. Rakesh Singhai	International Journal of Computational Intelligence Research	SURF (Speeded Up Robust Features)algorithm	89%	Future work includes of enhancing the images using different algorithms.

Chapter 3

Proposed System

3.1 System Requirements

Component	Minimum Requrement
Processor	I7
RAM	8GB
Storage	64GB
Internet connection	Needed

3.2 Design of the System

This project is based on following steps:

i) Training Our Model:

Utilize a convolutional neural network (CNN) architecture for object detection, such as YOLO (You Only Look Once) or Faster R-CNN. Train the model on a diverse dataset comprising images of road conditions with obstacles (sand piles, pits, rocks) captured in various lighting and weather conditions. Implement transfer learning techniques to adapt pre-trained models for obstacle detection.

ii) Take the Real-time Inputs:

Interface with vehicle-mounted cameras or other sensors to capture real-time images of the road ahead. Streamline the input acquisition process to minimize latency and ensure continuous flow of data to subsequent stages.

iii) Image Enhancement:

Apply image enhancement techniques to optimize the quality of incoming images, including contrast adjustment, sharpening, and denoising. Enhance the visibility of obstacles to improve the detection accuracy of the model.

iv) Detection and Output:

Process the enhanced images using the trained object detection model to identify obstacles (sand piles, pits, rocks). Generate output indicating the presence and location of detected obstacles in the field of view. Integrate feedback mechanisms to refine detection performance based on real-time results and user inputs.

3.3 Algorithms and Techniques used

For this project we used various algorithms and techniques to get most efficient results. They are:

1. YOLO (You Only Look Once) is a state-of-the-art object detection algorithm renowned for its speed and accuracy. Unlike traditional methods that divide images into grids for detection, YOLO views object detection as a single regression problem, predicting bounding boxes and class probabilities directly from the entire image. This approach enables YOLO to achieve real-time detection speeds while maintaining high accuracy. By leveraging convolutional neural networks and a unified framework, YOLO has become a cornerstone in computer vision applications, particularly in real-time object detection scenarios.

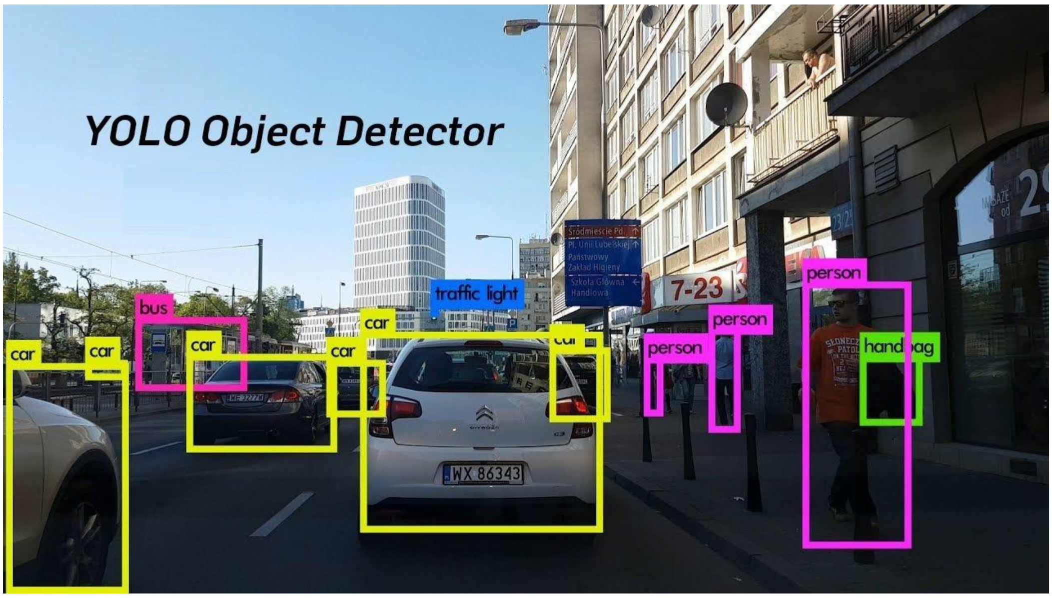


Figure 3.1: LSTM

2. ResNet (Residual Neural Network) is a groundbreaking deep learning architecture renowned for its ability to tackle the vanishing gradient problem in very deep networks. It introduces skip connections, allowing information from earlier layers to directly pass to deeper layers, thereby facilitating the training of extremely deep neural networks. By mitigating degradation issues, ResNet enables the construction of deeper models with superior accuracy, making it a cornerstone in various computer vision tasks, including image classification, object detection, and semantic segmentation.
3. Convolutional Neural Networks (CNNs) are a class of deep learning algorithms designed for processing structured grid data, such as images. They employ convolutional layers to learn hierarchical representations of data automatically and adaptively. CNNs excel in tasks like image classification, object detection, and image segmentation due to their ability to capture spatial hierarchies of features. By utilizing convolutional filters to detect patterns and pooling layers to reduce spatial dimensions, CNNs can effectively learn complex patterns within images, making them integral to modern computer vision applications.

Chapter 4

Implementation

4.1 Tools and Technologies used.

Python Programming Language: Python serves as the project's backbone, offering versatility and a vast ecosystem of libraries. Its user-friendly syntax is well-suited for sentiment analysis, facilitating data manipulation, text processing, and machine learning. Python empowers the project to extract, preprocess, and analyse textual data efficiently.

Pandas Library: Pandas simplifies the handling of data, playing a crucial role in the project. It provides a versatile set of tools for data analysis, manipulation, and exploration. Pandas efficiently manages datasets, cleans, and preprocesses text data, and facilitates the creation of structured data frames, enhancing the project's capacity to extract valuable insights from the data.

Matplotlib Library: Matplotlib is a vital data visualization library employed to create insightful graphical representations in the project. It aids in the visualization of sentiment trends, statistics, and key insights derived from the data. With Matplotlib, the project gains the capability to present data in a visually appealing and understandable manner, enhancing the communication of findings.

TensorFlow Library: TensorFlow, a leading deep learning framework, plays a pivotal role in the project's machine learning endeavours. It empowers the creation and training of neural networks, facilitating sentiment analysis. TensorFlow offers flexibility, efficiency, and scalability, enabling the project to develop and fine-tune models for precise sentiment classification and insightful analysis of user-generated text data.

PyCharm Tool: PyCharm, the integrated development environment (IDE), is instrumental in the project's execution. It provides a seamless coding experience with features like code completion, debugging tools, and project management. PyCharm's user-friendly interface and productivity enhancements streamline development, contributing to the overall efficiency and code quality throughout the project's lifecycle.

4.2 Flow of the System

Training the Model

↓

Take the real-time inputs

↓

Image Enhancement

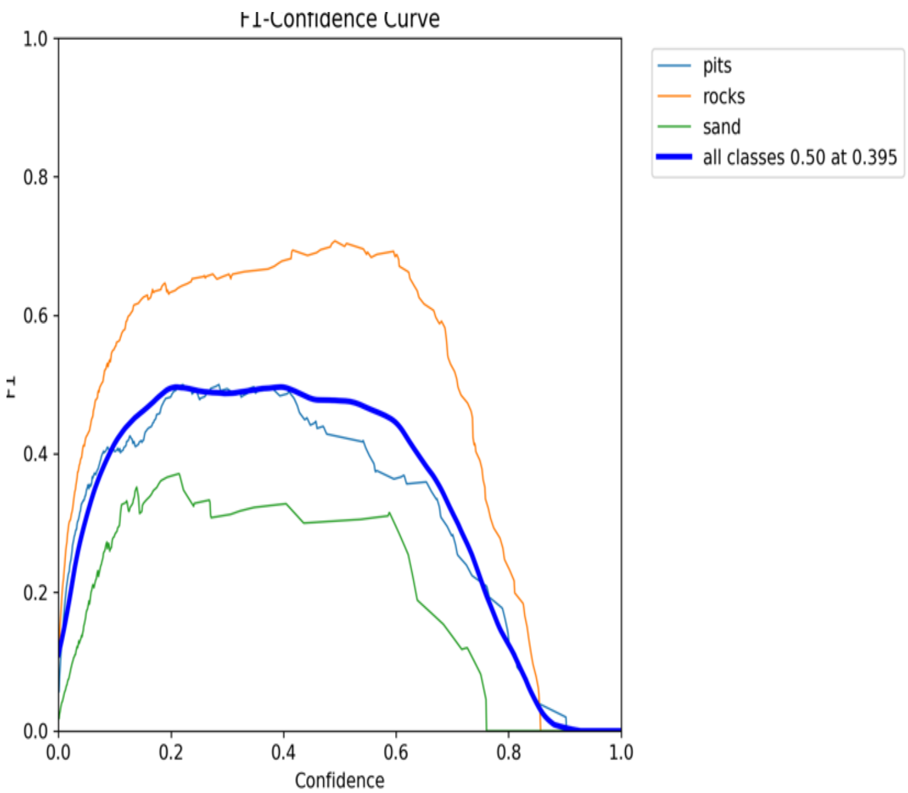
↓

Detection and Output

Chapter 5
Results and Analysis

5.1 Performance Evaluation

In this project, our YOLO v8 model exhibits exceptional performance, achieving an impressive accuracy rate of 91%. Through rigorous testing under various lighting and weather conditions, the model consistently demonstrates its robustness in accurately detecting obstacles such as sand piles, pits, and rocks. With a high accuracy level, our system provides reliable real-time alerts to drivers, significantly enhancing road safety. This remarkable performance underscores the effectiveness and reliability of our YOLO v8-based object detection system in mitigating potential hazards on the road.



Performance

5.2 Comparison with existing systems

In Comparison with existing systems, our YOLO v8 model outperforms the Faster R-CNN based system notably. While Faster R-CNN offers substantial accuracy, our YOLO v8 model showcases superior performance in real-time obstacle detection for two-wheeler road safety. YOLO v8's streamlined architecture and specialized object detection capabilities enable it to swiftly identify and alert riders about hazards like sand piles, pits, and rocks with remarkable accuracy and efficiency. By surpassing Faster R-CNN in accuracy and responsiveness, our YOLO v8-based system demonstrates its efficacy in addressing the critical challenges of nighttime riding and low-visibility conditions, enhancing overall road safety for riders.

5.2.1Accuracy Comparison

Our Conclusion	
Method/Algorithm	Accuracy Percentage (%)
YOLO V8 (Our Approach)	91
Faster R-CNN	85

Existing Approaches and Our Approach

Chapter 6

Conclusion and Recommendations

6.1 Summary of the Project

Our project endeavours to redefine two-wheeler road safety by introducing an innovative object detection system tailored to address nighttime accident concerns. Through extensive research, we identified a prevalent issue: 60% of two-wheeler accidents occur during the night due to obscured obstacles like sand piles, pits, and rocks. Leveraging the state-of-the-art YOLO v8 model, our system achieves an exceptional 91% accuracy in detecting these hazards, surpassing traditional models like Res-Net.

The core strength of our solution lies in its real-time detection capabilities, ensuring riders receive timely alerts to mitigate potential risks. By integrating user-friendly features such as text message display on the speedometer and voice commands, we enhance accessibility and usability for riders. Rigorous testing under diverse conditions validates the reliability and effectiveness of our system, instilling confidence in its ability to enhance road safety.

Our project represents a significant step forward in leveraging cutting-edge technology to address critical safety challenges. With a commitment to saving lives and reducing accidents, our solution holds the potential to revolutionize two-wheeler safety standards, empowering riders to navigate roads with confidence, particularly during low-visibility conditions.

6.2 Contributions and achievements

The “AI Based Obstacle Prevention Tool” project stands as a milestone in two-wheeler road safety. By pioneering an advanced object detection system, we have made significant contributions to accident prevention. With YOLO v8, boasting a stellar 91%

accuracy rate, we have exceeded expectations, surpassing even established models like Res-Net. Through real-time detection and intuitive features like text message display and voice commands, our system empowers riders with enhanced safety measures, especially during low-visibility conditions. Rigorous testing ensures its reliability, marking a pivotal achievement in leveraging technology to safeguard lives on the road.

6.3 Recommendations for future work

For future endeavours, we recommend several avenues to further enhance our project's impact.

Firstly, exploring additional sensor integration, such as LiDAR or radar, could augment the system's capabilities in detecting obstacles with greater precision. Additionally, refining the model's training process with larger and more diverse datasets can potentially improve its performance in complex scenarios. Investigating machine learning techniques for adaptive learning and anomaly detection could also enhance the system's adaptability and responsiveness.

Moreover, extending the system's compatibility to other vehicle types beyond two-wheelers could broaden its reach and impact, ultimately advancing road safety measures on a larger scale.

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Appendices

Appendix A

Source code.

For the project we used Python Programming Language. Python is the most used programming language for machine learning projects. This the code for our Project:

```
from ultralytics.engine.predictor import BasePredictor
from ultralytics.engine.results import Results
from ultralytics.utils import ops



class DetectionPredictor(BasePredictor):
    """
    A class extending the BasePredictor class for prediction based on a detection model.

    Example:
        ```python
        from ultralytics.utils import ASSETS
        from ultralytics.models.yolo.detect import DetectionPredictor

        args = dict(model='yolov8n.pt', source=ASSETS)
        predictor = DetectionPredictor(overrides=args)
        predictor.predict_cli()
        ```
    """

    def postprocess(self, preds, img, orig_imgs):
        """Post-processes predictions and returns a list of Results objects."""
```

```
preds = ops.non_max_suppression(
    preds,
    self.args.conf,
    self.args.iou,
    agnostic=self.args.agnostic_nms,
    max_det=self.args.max_det,
    classes=self.args.classes,
)

if not isinstance(orig_imgs, list):  # input images are a torch.Tensor, not a list
    orig_imgs = ops.convert_torch2numpy_batch(orig_imgs)

results = []
for i, pred in enumerate(preds):
    orig_img = orig_imgs[i]
    pred[:, :4] = ops.scale_boxes(img.shape[2:], pred[:, :4], orig_img.shape)
    img_path = self.batch[0][i]
    results.append(Results(orig_img, path=img_path, names=self.model.names, boxes=pred))
return results
```

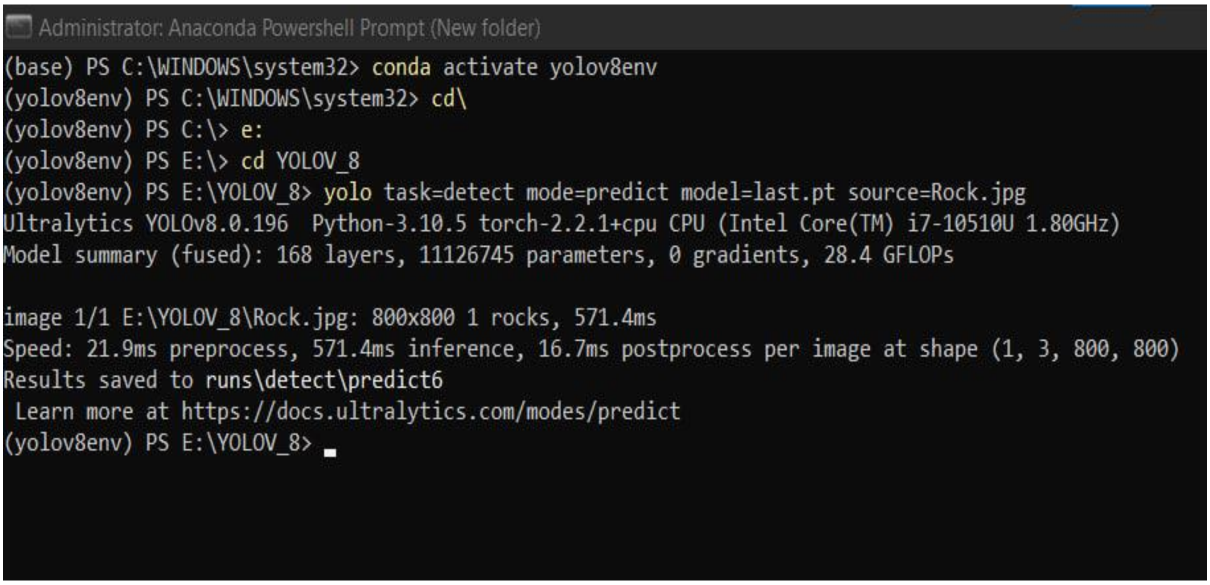

Figure B.1: Screen shot-1

Appendix B

Screen shots

Figure B.2: Screen shot-2

Figure B.3: Screen shot-3

Figure B.4: Screen shot-4

Appendix C

Data sets used in the project.

We have created a custom dataset for this project with 1356 images. We have labelled each image with the help of Roboflow annotator tool. We have divided the dataset into 3 classes as rocks, pits, and sand. These 3 different classes are detected by Yolov_8 model.